

## Don't Hold Your Breath

### Indoor CO<sub>2</sub> Exposure and Impaired Decision Making

Elevated indoor levels of carbon dioxide (CO<sub>2</sub>) have been associated with impaired work/school performance, a variety of health symptoms, and poor air quality. But CO<sub>2</sub> has been assumed to be simply a marker of poor ventilation rather than a detrimental exposure unto itself. Now researchers document evidence of adverse effects on adult decision-making performance associated with exposure to commonly encountered indoor levels of CO<sub>2</sub>, even at fixed high ventilation rates [*EHP* 120(12):1671–1677; Satish et al.].

Typical outdoor CO<sub>2</sub> concentrations range from approximately 380 ppm to a high of about 500 ppm. Average indoor concentrations tend to be higher because occupants exhale CO<sub>2</sub>. Some studies suggest CO<sub>2</sub> levels in crowded indoor spaces such as conference rooms, classrooms, and aircraft cabins can reach several thousand ppm. The American Society of Heating, Refrigerating and Air-Conditioning Engineers recommends a maximum indoor CO<sub>2</sub> level of 1,000 ppm as a marker of adequate ventilation.

In the current study, researchers exposed 22 university students to CO<sub>2</sub> concentrations of 600, 1,000, and 2,500 ppm in a controlled

environmental chamber simulating an office environment. Participants were exposed to each concentration for 2.5 hours; all exposures occurred over the course of one day, but their sequence varied among participants. Ventilation rate, temperature, relative humidity, and other key factors were unchanged across exposures.

During each session, the participants engaged in a variety of activities, including computer-based questionnaires on perception of air quality and health symptoms. In the last 1.5 hours of each exposure, after a brief training session, they completed computer-based tests designed to analyze their decision-making performance.

The investigators observed a moderate decrease in performance for 6 of 9 decision-making measures at CO<sub>2</sub> concentrations of 1,000 ppm and a more substantial decrease for 7 of 9 measures at 2,500 ppm. The authors note that the findings need to be confirmed but suggest, in a surprising turnabout, that CO<sub>2</sub> should be considered an indoor pollutant, not just a proxy for other toxic pollutants. The findings also support the enforcement of current ventilation standards in buildings, and argue against reducing ventilation for the sake of energy savings.

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## Crispy Cravings May Affect Baby's Health

### Prenatal Acrylamide Exposure Is Associated with Reduced Birth Weight

Many commonly eaten foods contain acrylamide, a known neurotoxicant and suspected human carcinogen. Previous animal studies have suggested acrylamide may also cause reduced birth weight in prenatally exposed offspring. Investigators now report an association between higher concentrations of acrylamide and glycidamide hemoglobin adducts in umbilical cord blood and reduced birth weight in children of women who ate diets rich in acrylamide [*EHP* 120(12):1739–1745; Pedersen et al.].

Acrylamide forms during frying or high-temperature baking of carbohydrate-rich foods such as fried potatoes, potato chips, cookies, and breakfast cereals. Within the body, acrylamide and its metabolite glycidamide form adducts, or chemically joined products, with proteins and DNA. These adducts can potentially disrupt genetic and biological functions.

Pregnant women at 11 locations in Denmark, Greece, Norway, Spain, and England participated in the study during 2006–2011, and the investigators used information on 1,101 mother–child pairs. Demographic and detailed dietary information was collected from all the women, umbilical cord blood samples were obtained at birth, and birth information was extracted from medical records.

Acrylamide and glycidamide hemoglobin adducts were found in all cord blood samples, and levels tended to be higher if the mother smoked. Subsequent analyses accounted for maternal smoking as well as other potentially confounding factors, such as length of pregnancy, child's sex and country of birth, and mother's age, prepregnancy weight, and ethnicity.

The investigators found an association between decreasing birth weight and increasing levels of adducts. In a comparison of the highest and lowest quartiles of exposure among children of nonsmoking mothers, acrylamide and glycidamide were associated with average birth weight decreases of 107 and 103 g (3.8 and 3.6 oz), respectively. These decreases are comparable with those attributed to moderate



smoking during pregnancy. Reduced birth weight is linked with adverse health effects such as impaired growth and development early in life and increased incidence of cardiovascular disease, diabetes, and osteoporosis in adulthood.

The availability of adduct measurements and the large, well-characterized study population are key strengths of the study. However, there remained the potential for unmeasured or uncontrolled factors to influence the results. Furthermore, it was not possible to precisely characterize dietary acrylamide intake, because even in the same types of foods, levels can vary depending on manufacturing and preparation methods. If confirmed by further research, the results of this study suggest that pregnant women may benefit from reduced consumption of acrylamide-containing foods.

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